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Science and Art Gossip.

In Knowledge for December 2, 1881 (No. 5), there appeared among our "Answers to Correspondents," the following:—

J. Norman Lockyer.—We regret that you cannot at present spare time. Professor Young has promised to write on the subject, and your treatment of it, from another point of view, would doubtless have been interesting to our readers. Perhaps at some future time you can oblige us.

We learn now for the first time (a railway train travelling 500 miles a day would have covered more than the moon's distance from us in the interval) that Mr. Lockyer was offended at our answering in this way what he regarded as a private communication—to wit his letter declining, rather curtly, our invitation to him to contribute to these columns. We learn this from a coarsely-worded post-card communication forwarded to our publishers. A paragraph stating, truly, that we had (with perhaps unwise generosity) invited one who loves us not to write in these columns (at more than twice the rate at which we had been paid before the fatal year 1869 of Mr. Lockyer's corona mistakes—*when even accepted articles, some already in type, were returned to us*—for contributions to *Nature*), but that he was not willing to accept our invitation, would have been strictly *en règle*. We cannot see, then, that our less public reference to the matter was open to exception. But if it was, exception should have been taken *then*, not now. And even exception taken at the right time might have been conveyed in better form than on a postcard, unsigned, in a disguised hand, and full of illbred vituperation. [We cannot be wrong in assigning this communication to the one person living besides ourself who could know *and care* anything about the matter to which it makes indignant reference.] Those who attended our lecture on "The Sun," at St. James's Hall, and heard our pointedly complimentary reference to Mr. Lockyer's work in 1868, will know how generously we have been disposed to treat him. But—"the rest is silence."

The course of lectures on astronomy, at St. James's Hall, came most pleasantly to a conclusion last Saturday. A kinder and more sympathetic audience I have never addressed. I took occasion, when the lights were being turned down (though usually not very willing, even at that time, to interrupt a lecture by the introduction of personal matters), to thank my hearers for their kindly attention and pleasant ways generally. Then I made a few remarks about the utter neglect with which the London press treats all scientific lectures. Huxley, Tyndall, Owen, and others lecture, either without a word of notice, or—if any notice at all is accorded—some wretched paragraph, as wanting in correctness as in appreciation. My own lectures had an additional claim in being an experiment, made at the risk of considerable loss, and not the less deserving notice that they had been most remarkably successful. I am told that a remark made by one of the audience, which sounded to me like "You're right, Mr. Proctor," ran really to the effect, "No light, Mr. Proctor," and was intended to explain that the lectures, being partly given in the dark, could not be properly reported. I was referring, however, to the absence rather of notices than of reports, though a report of the part of each lecture given before the light was turned down would have made in effect a good abstract of the whole lecture. As forty or fifty course tickets (sofa stalls) were given to the Press, and scarce half-a-dozen short notices appeared, I think I had some reason to——; but, there, I suppose the courtesy and kindness of the American and Australasian Press have spoiled me.

I am told that, after the lecture, prolonged efforts were made to recall me. It was not from any want of recognition of the audience's kindness that I failed to return, though I must admit to a strong repugnance to the obtrusion of a lecturer's small self before an audience just after he has been endeavouring to take them along with him away from this earth, through infinities of space and time to contemplate infinite power, all-present and everlasting law. But, as a matter of fact, I was in Piccadilly before any of the audience who had heard the closing words of the lecture; and I suppose (from all I learn) that I was half way to Victoria when the audience were beginning to wonder at my failing to reappear on the platform.

My exit was not accomplished quite so quickly on this occasion as once when I lectured at the Horticultural Hall, in Boston, Mass., and "Dinorah" was performed at the Boston Opera House. Immediately after my peroration, I ran through a long hall under that which contained the audience, seeing the first few as they came down the stairs leading from the entrance to the lecture hall; a moment later I was in a carriage sent to meet me by a friend, and I believe that all the audience were not well out of the hall when I took my seat just as the second act of "Dinorah" was beginning. Marimon in the "Shadow Song" was well worth running to hear. It is a rather singular coincidence that the only other time when I have been as quick to escape after a lecture—to wit, when I had been lecturing in the summer of 1879 for the National Temperance League (but on astronomy)—I was just in time to hear Patti in the "Shadow Song."

The spire of the General Assembly Hall, Edinburgh, has just been fitted up with a new lightning-conductor. Some doubt having been expressed, says the local press, as to the efficiency of the old conductor, it was resolved to subject it to a strict test, and for this purpose a copper wire was carried by a "Steeple Jack" up one side of the spire and attached to the conductor on the other side. When the connection was effected, the electrical resistance is said to

have reached the "very alarming amount of 800 Ohms." The conductor was jointed together by screw couplings, and this extraordinary resistance is explained to have been due to the "defective character of many of those couplings." The resistance of a good conductor should not exceed 1 Ohm.

The management of the Savoy Theatre having determined to abolish gas-fittings altogether in the entrance, corridors, and offices, Messrs. Faraday & Son are supplying some tasteful fixtures for the Swan lamps, with which Messrs. Siemen Brothers are replacing them.

The model theatre of Brünn is illuminated by electricity, and also provided with an electrical safety apparatus, devised by Robert Langstouff Haviland, for use in the event of fire breaking out. By means of an electro-magnet the incombustible curtain between the stage and auditorium is allowed to fall; the valves of water pipes are opened, so as to discharge copious volumes of water on various parts of the building; extra doors are opened, and ventilators are closed.

The experiment of electrically lighting the dining-room and libraries of the House of Commons has, it is stated, cost more than £2,000, but the Commissioner of Works contracted to pay a sum not exceeding £900.

Professor Palmieri has devised a process for silvering glass by means of the reducing action on the salts of silver, which is said to have the advantage of producing a very brilliant metallic deposit. When into an ammoniacal solution of nitrate of silver is poured, first a little caustic potash, and then a few drops of glycerine, the reduction begins at once; and this action is accelerated if ether or alcohol be added to the mixture. A moderate heat and darkness are said to increase the brilliancy of the precipitate, and darkness also favours the adhesion to the mirror of the deposit.

The Council of the Society of Arts have appointed a committee to consider the question of preventing collisions at sea. The work of the committee will be confined to a consideration of the best means of preventing collisions in fogs. The committee will be glad to receive any information on this subject from persons who have given their attention to it, or to consider any proposals having for their object the prevention of such collisions. All such communications should be addressed to the secretary of the Society of Arts, John-street, Adelphi.

Mr. John F. Schultz, of New York, has conceived the idea of preventing collisions at sea in a fog, by means of balloons. He proposes that all vessels should be provided with balloons of sufficient capacity to take a person high enough above the fog to see balloons from other vessels that may be in the vicinity. The relative positions of the different vessels are then communicated to the captain or other officer of the ship, and, by signals between the look-out men in the balloons, the direction of the vessels is so controlled as to avoid collision. The inventor does not state how the man in the balloon is to communicate with the officers of his ship, but it is presumed by an electric wire attached to the cable-line by which the balloon is fastened to the ship's deck. Mr. Schultz does not confine himself to the idea of using balloons on ships alone for preventing collisions, but he thinks lighthouses, life-saving stations, &c., should be provided with balloons, properly manned, to warn vessels of their approach to land. The inventor of the balloon collision-preventing idea suggests that the present year, 1883, is a most appropriate time for introducing his system, as it marks an event in ballooning, it being just one hundred years ago that Montgolfier introduced his balloon to the world.

The total number of puddling furnaces in operation at the end of 1882 in the United Kingdom was 4,369, being 814 less than in the preceding year.

During a discussion at the meeting of the Society of Telegraph Engineers, yesterday week, Mr. Stroh said he had been endeavouring to examine microphonic actions with the aid of a microscope. He used platinum electrodes separated by an oily film, and using only one cell, actually saw the oil boil vigorously and partially volatilise. The telephone and microphone are at present receiving considerable attention at the hands of the society, which has devoted the last two meetings to their discussion, and has also allotted the next to the same subject. A new condenser telephone will then, in all probability, be introduced.

The American Bell Telephone Company has, it is said, erected two million miles of overhead wires during the past year.

Telegraph Wire Struck by Lightning.—The *Electrician* is informed by an eye-witness that:—"On March 1, near the village of Lacofranco, a flash of lightning struck the line wire about midway between two poles. The current divided and rushed along the wire to either pole, completely destroying the whole of the wire short up to the insulators, where, with a loud report, it jumped to the iron poles and made earth. The length of wire destroyed was eighty-five yards. The size of wire was No. 8 B.W.G. galvanised iron. The two ends have a purplish hue, and are like hardened steel. The cups of the insulators (white porcelain) were broken, the upper parts being covered with a purplish, metallic-looking coating, radiating from where the line was attacked. The coating is thoroughly burnt into the glaze of the porcelain. The inside of the cups, nearest to where the electric fluid sprang from the line to the iron pole, is covered with a fine, dark, metallic-looking deposit, which is also burnt into the porcelain."

Petroleum in the Argentine Republic.—Petroleum deposits of great richness and extent are said to have been recently discovered in the upper provinces of the Argentine Republic, and it is believed that the eastern slopes of the Sierras of the Andes are underlaid in many places with the oil. One of the deposits, in the province of Jujuy, consists of a lake of about eighty-eight acres in extent, and of unknown depth, and is covered with asphalte. The liquid itself is somewhat thick, of a black colour, and has no disagreeable odour. It is pronounced equal to the best American petroleum. Deposits of petroleum have also been recently discovered in the province of Mendoza; one of these is only a few miles south-west of the old site of the city of Mendoza, destroyed by earthquake in 1861, and a concession has already been granted by the Government for working these deposits. According to an analysis made in England, excellent results are obtained; the yield is stated to be nearly 40 per cent. of kerosine, and what adds to the importance of the deposit is the fact that the oil flows to the surface, and thus affords a constant supply of crude petroleum.—*Engineering.*

A NATURALIST'S YEAR.

By Grant Allen.

XI.—MARSH MARIGOLD.

IF any promising young æsthete wants to introduce a pleasing variation on the monotony of sunflowers and daffodils, he cannot do better than set up an original fashion of his own for admiring our common beautiful bright English marsh-marigolds. Except, perhaps, the globe-flower and the greater spearwort, no British blossom can vie with them in the brilliancy of their golden colouring; and when they grow naturally among their own broad, heart-shaped, glossy-green foliage on a patch of spongy ground beside some little brooklet, they are as beautiful objects as even the most fastidious of decorative artists could wish to feast his eyes upon. At first sight, the marsh-marigold looks like a very big yellow buttercup, only richer in hue and more luxuriant in its marshy growth: and so it really is in all fundamental essentials; but it differs more widely from the true buttercup type in many important points of structure than most unbotanical observers would easily imagine at a first rough glance. I pulled to pieces a common meadow-buttercup and examined its structure here one day a twelvemonth since; let us pull to pieces a marsh-marigold in like fashion together this morning, and see what are the noteworthy points of agreement and difference between the two types.

The first thing that strikes one about the marsh-marigold is the fact that, in spite of its brilliant golden colour, it has really no petals. This is certainly rather a surprise to the lover of flowers who, for the first time, examines closely one of these lovely April blossoms: for the sepals or calyx-pieces are so large, so broadly expanded, so brightly coloured, and so exactly like the buttercup petals in hue and shape, that it is almost impossible at first to believe they do not really belong to the corolla. You might almost, for a moment, imagine that the true sepals were very short-lived, as in the poppy and the yellow eschscholtzias of our flower-gardens, and that they had fallen off from the open blossoms at an extremely early stage, leaving the yellow petals as the apparent outer whorl of the entire flower. But when you come to examine an unopened bud upon the same plant, you will see at once that this explanation is not the true one, and that the large coloured petal-like organs are, in fact, the sepals, and no other part whatsoever. You will find that in the youngest buds of all they are green and quite external; and that, as they grow older, they get gradually larger and yellower, until at last they expand into the perfect similitude of five big, bright golden petals. It is quite clear, then, that for some good reason of its own, the plant has so specialised the outermost or true calyx-whorl of flower-leaves, as to perform the function usually performed by the second or corolline row for other blossoms.

When we examine the intermediate stages, or the analogous cases elsewhere, the reason for this curious—I had almost said this wanton—proceeding, becomes fairly obvious. Even in the buttercup, the calyx-pieces are faintly coloured, though they serve no attractive purpose in the economy of the plant, being rather provided with a hairy outer coat, so as to prevent thieving ants from creeping up to steal the honey. Inside this protective whorl comes the corolla of five golden petals, each with a nectary at its base, to attract the fertilising bee. But most buttercups are rather cup-shaped; and in many cup-shaped flowers it happens that from certain points of view the calyx becomes really far more conspicuous than the corolla. Wherever this is the case, it is usual to find the calyx-pieces at least as brightly coloured as the petals; for, under such circumstances, any heightening of the faint colouration almost always displayed by the calyx would prove beneficial to the species by aiding in the attractiveness of its general display, and would therefore be favoured by natural selection. For example, in this very same buttercup family there are three or four developed tribes, such as the monkshoods, the larkspurs, and the Christmas roses, in all of which the large cup-shaped, or bell-shaped, or helmet-shaped sepals are more exposed to view than the small honey-bearing petals; and in all, the sepals accordingly, rather than the petals, form the attractive advertising organ. The plants, in short, are good advertisers; they insert their colour advertisements in the best available medium.

Now, we have a rare wild plant in some parts of England and Wales—the globe-flower—which to some extent stands half-way in this respect between the buttercup and the marsh-marigold. It has from ten to fifteen large concave golden sepals outside each blossom, and these form, as in the marsh-marigold, the real alluring surface. But inside them it still retains a set of small, long, narrow yellow petals, dwarfed almost out of recognition, and quite flat, because, though they secrete honey, they no longer take any part in the real function of attracting insects from a distance. To a certain extent, therefore, I said, we may regard the globe-flower as representing a middle stage between the buttercup and the marsh-marigold. Still, we must not consider that our own species is really an exactly intermediate form, because, while the buttercup has five sepals and petals, and while the marsh-marigold has also five sepals, the sepals and petals of the English globe-flower usually number from ten to fifteen each. There are, however, foreign globe-flowers with only five of either kind, and one of these may perhaps be, in fact, a genuine link between the two tribes—the ancestral and the derivative.

From some such ancestor as this, then—a buttercup with five large, bright golden sepals, and five tiny, dwarfed petals—our English marsh-marigold is probably descended. But it has acquired a peculiarity of its own which has enabled it to dispense with its rudimentary petals, and so to effect a complete saving of the material which would otherwise have gone to make them up; for it has taken to secreting the honey in the very centre of the flower, on the young seed-vessels themselves, a habit which, of course, renders the little narrow petals quite unnecessary. Accordingly, through the working of what is called the law of parsimony (by which all useless parts grow gradually obsolete), it has now lost them altogether, retaining only the very large and petal-like yellow calyx-pieces.

At the same time our plant has undergone another important structural change, which it also shares with the globe-flowers and with all the higher buttercup kinds, such as the monkshood and the columbine. In the centre of the common meadow buttercup, you will recollect, there are several rows of small, solitary, one-seeded carpels, all mixed together into a very irregular unsymmetrical crowd. This was apparently the earliest condition of the pistil (or unripe fruit) in all primitive plants; certainly it is the condition of the pistil in all the simplest and most aboriginal surviving examples. But as plants develop better means of cross-fertilisation by means of insects, and rise higher in the scale of organisation, it pays them better to lessen the number of such carpels, and to put several seeds in each of them instead of one only. In other words, those which happen from time to time to have the fewest carpels, and the most seeds in each carpel, survive and thrive best, while those which reverse this rule run the poorest chance in the struggle

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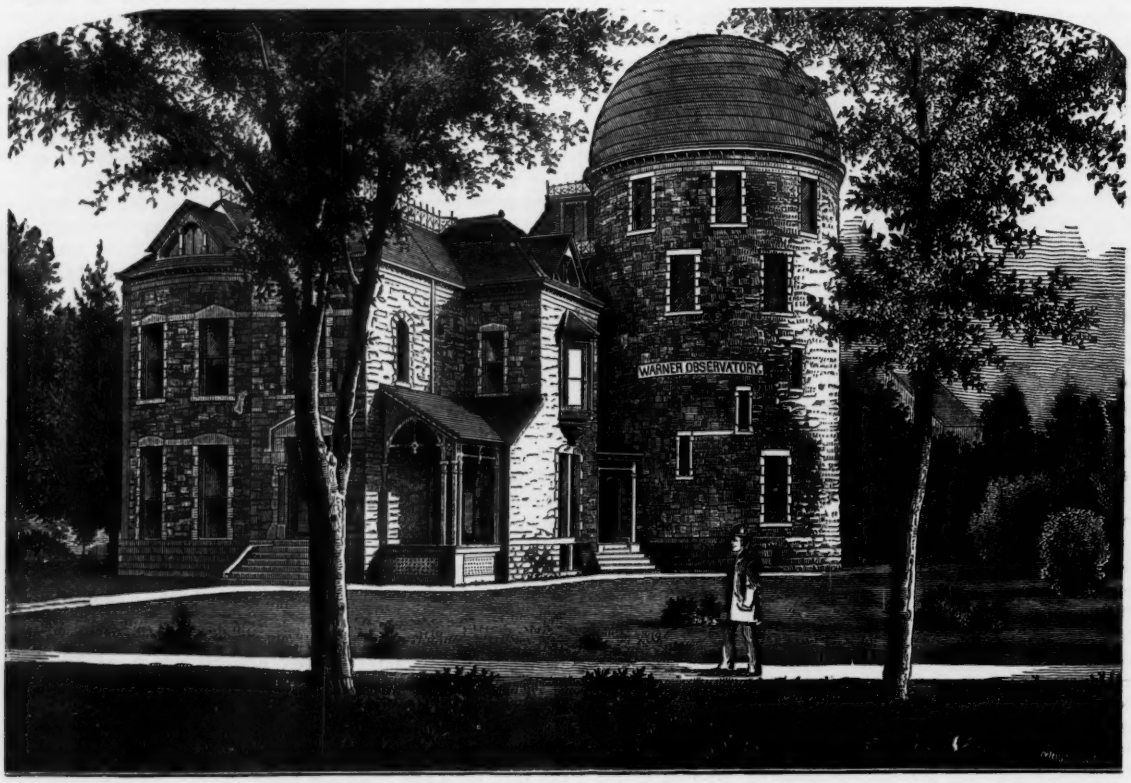
for existence. It is easier to fertilise five or ten carpels, with six or a dozen seeds apiece, than to fertilise fifty with one in each. A glance at a bunch of marsh-marigolds in various stages of maturity will show at once the *rationale* of this principle. In the youngest flowers, the outermost stamens only are mature; as they grow older, the inner rows of stamens ripen one after another; and at last the carpels themselves become fit to be impregnated with pollen from a neighbouring blossom. As the bee (or other visitor) bends over the different flowers, he collects pollen from the younger ones, and conveys it immediately to the sensitive surfaces of their elder sisters. Thus a single act suffices to fertilise the whole set of carpels, which have accordingly been reduced from the irregular mob of the buttercup to a single row of five, or sometimes a double one of ten, for the numbers fluctuate considerably between these two extremes. Each carpel contains several seeds, and grows out at last into a little dry brown follicle. Such economy of parts is one of the best tests of relative evolution in the vegetable hierarchy.

It is curious to note, however, that while all this development has taken place in the flowers, the foliage still remains essentially true to a very primitive buttercup type. The beautiful, big, glossy leaves of the marsh-marigold are almost identical in shape, texture, and, in fact, everything but size with the much smaller leaves of a true buttercup, the lesser celandine, now flowering abundantly in all the meadows and hedgerows around us. Such constancy is interesting, but by no means unusual; for in like manner the globe-flower almost exactly reproduces the other type of buttercup foliage so familiar to us all in the common English meadow species. The reason is that the circumstances of the two similar plants are in both cases all but precisely the same. The family leaf remains at bottom identical throughout, but it fills itself out more or less, according to the supply it obtains of food and sunshine. Hence the marsh-marigold, growing as a rank perennial with a rich and almost bulbous root-stock in fertile marshy places, can afford to produce very large and well-filled leaves; while the lesser celandine, a smaller plant of somewhat similar habits, but possessing only little sausage-shaped tubers, and growing in less favourable situations, can not attain the same breadth of leaf, though it rounds each leaf to an equal degree; and the meadow buttercups, subjected to the fiercer competition of the summer grasses and clovers, have to divide up their foliage into numerous much-cut segments, in order to intercept whatever little light and air is permitted to reach them by their greedy neighbours.



THE WARNER OBSERVATORY.

(ROCHESTER, N.Y.)

By G. W. Elliott, M.A.

To the Editor of Knowledge.

Sir,—During my recent residence in London I read Knowledge with interest every week, and this will perhaps explain, and in a measure atone for, my freedom in addressing you. Constant perusal of a paper so thoroughly and refreshingly infused with an active personality as is Knowledge makes the reader feel as if he were well acquainted with the Editor, even though he has never seen him.

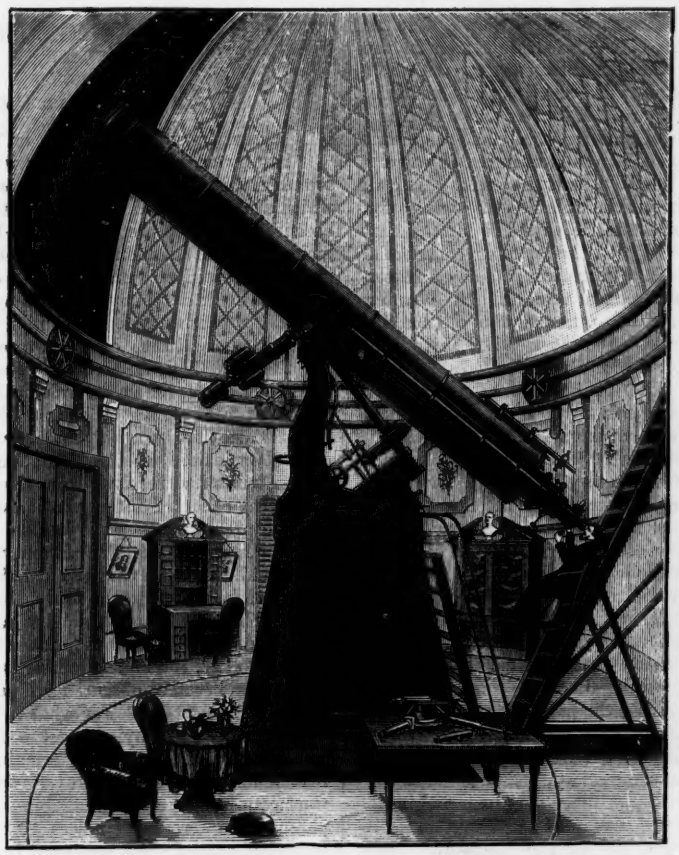
On my return to the States I find that the Warner Observatory has been completed, and is now occupied by Mr. Lewis Swift, Ph.D., R.A.S., the well-known comet-finder. Presuming that you would be interested in learning all about the latest addition to astronomical facilities in the

New World, I venture to send you a brief description of the building, furnishings, observatory and telescope, and in addition, by the kindness of Mr. Warner, I am able to send also an electrotype of the exterior and interior views of the Observatory.

The building was begun in 1880, and was slowly constructed, so that the foundations might be well set before the roof was put on and the telescope mounted. It is located on the corner of East Avenue—the finest street in the city—and Arnold Park, the finest private park in this city of private parks. It is constructed of Lockport white sandstone, rough ashler, and is the most noteworthy structure in the city, and probably the finest private observatory in the world. The entire establishment cost about £16,000 made large and heavy to prevent flexure. The two circles are respectively 24 and 30 in. in diameter, graduated in silver. It is driven by clockwork, and is provided with a full battery of eye-pieces, having powers from 50 to 2,500 diameters. From the following list of prominent private observatories, it will be seen that this telescope surpasses all in size and power :—

Draper's, Hasting-on-Hudson	11 inches.
Morrison's, Glasgow, Mo., U.S.A. ...	12¼ „
Rutherfurd's, New York, U.S.A. ...	13 „
Crawford's, Dunecht, Scotland	15 „
Warner's, Rochester, N.Y., U.S.A..	16 „

It is 2½ inches larger than that in your Greenwich



($80,000). The interior is finished in the finest native hard woods, and is tastefully decorated and furnished. An elevator (lift) conducts to the floor under the operating-room, the latter thence being reached by a cut-off staircase, which excludes all currents of warm air from below. The observing room is four stories from the ground, has an interior diameter of thirty feet, and a height of thirty feet from floor to peak of dome. It is abundantly supplied with cold air, and in the summer season the dome can be readily and quickly cooled.

To avoid the jar of the neighbouring railway, the pier is laid on a bed of sandy earth considerably above bed rock. The telescope is a refractor, having an aperture of 16 in. clear, and a focal length of 22 ft. When in perpendicular position its object-glass is 25 ft., and its eye-glass thrown 3 ft. from the floor. The cylinder is of sheet steel,

Observatory, which is the most elaborately equipped of all observatories. The telescope is provided with devices for rough setting both in R.A. and Declination. The observatory possesses a positive micrometer and Burnham's device for illuminating the wires with dark field. The field can also be made bright with dark wires. The telescope has two comet eye-pieces, one negative, the other periscopic and positive, for working on nebulæ, and for the detection of expected comets. Mr. Swift will use his old four and one half-inch telescope for comet-seeking. He tells me he is preparing a chart of all known nebulæ, for the benefit of comet-searchers.

Mr. Hiram Sibley, of this city, one of the heaviest capitalists of the country, and a well-known benefactor to several American universities, has presented the observatory with the finest spectroscope that could be made, and

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another wealthy Rochesterian has given a sidereal clock; so that, altogether, the institution is splendidly equipped, and Dr. Swift, the director, will certainly lack nothing in the way of facilities for making astronomical discoveries.

In the drawing-room of the Observatory Dr. Swift has a large album containing the photographs of all the professional and non-professional astronomers of America, and he tells me he hopes to obtain the photographs of all the European astronomers for the Observatory.

Mr. H. H. Warner, the donor of this magnificent institution, is but forty years of age. His ancestors belong to the Warner family of Kent and Essex, several of whose members emigrated to this country in the seventeenth century, and settled in the New England States. His maternal ancestors came over in the *Mayflower*. Twelve years ago he came to Rochester with less than £20 in his pocket. To-day he is one of the wealthiest men in the city. In 1872 he took the general agency for the whole United States of a well-known fire and burglar-proof safe, and since then has sold over 60,000 safes, and made, and lost, and made again, a handsome fortune. His career has been almost phenomenal. He was not regarded when a boy as extraordinarily capable, but he felt his own power, and when labouring at the uninteresting work of a farmer upon his father's estate, he vowed to himself that he would write his name high on the scroll of commercial success, and he has done it. There is not to-day a better-known manufacturer in America than H. H. Warner. Last June, in recognition of his generosity to science, the American Association for the Advancement of Science, at its Montreal session, elected him a member. In 1881, he offered a Comet prize of $200 in gold for each American or Canadian discovery of a telescopic unexpected comet. During the same year he gave a prize of $200 in gold for the best essay on comets, which was won by Mr. Lewis Boss, director Dudley Observatory, Albany, New York, U.S.A., whose essay is said to be one of the finest monographs ever written on comets. The previous year he gave Prof. Swift $500 for his cometary finds. In 1882 he renewed his $200 prize for cometary discoveries in the United States, Canada, and Great Britain, and established a prize of $200 for each meteoric stone with organic remains, and $50 for each meteoric stone without organic remains, seen to fall in Canada or the United States during the year. Fifteen hundred dollars have been awarded by him under these prizes, during the past two years.

He not only built, fitted, and furnished the Warner Observatory, but he maintains Dr. Lewis Swift in his position as director, on a handsome salary.

As an indication of the large place this man fills in the American commercial world, it may be noted that he is president and heaviest stockholder in the Rochester Grape Sugar Company, having a capital of 1,000,000 dols.; is director of the Horse Shoe Silver Mining Company, having a capital of 1,000,000 dols.; is the heaviest dealer in safes in the United States, having done last year 800,000 dols. worth of business; and his Safe Kidney and Liver Cure establishment did between two and three million dollars worth of business in 1882. And this is the record of twelve years of the hardest kind of hard work under the most discouraging circumstances. He has emphatically commanded success by deserving it. Besides his benevolence to science, he is a man of large charity, of generous, undemonstrative nature, and is highly esteemed in this city of his home.

You will pardon my particularity in portraying his successes; I fanced it would not be without interest to your readers, as one illustration of the phenomenal growth of fortune in this new and wide-awake country.

Dr. Swift's successes in astronomical discovery have had a local inspiration, and during the past two years the section of astronomy of the Academy of Sciences has been in active operation. There are about a dozen private telescopes now owned by the members, and there is not a clear night in the year when the sky is not diligently searched for old and new astronomical facts, within the horizon of Rochester. The Rochester Astronomical Society, an organisation in connection with the Warner Observatory, also sends out announcements by mail and telegraph to all the papers of the country of all astronomical discoveries; and Mr. Warner also generously bears the expense of these bulletins.

THE BIRTH AND GROWTH OF MYTH.

VI.

By Edward Clodd.

IN a former paper, the facts on which the solar theory rests were summarised as witnessing to its inherent soundness, and we must now glance at certain other facts which are overlooked by its exponents. A needful task; because the claims preferred on its behalf to explain every incident in the complex mythology of the Greek and other races has caused a recoil in minds otherwise well disposed towards it. In fact, any one reading, without such caution as this paper is designed to supply, the minute analyses of myths in the writings of those who interpret them solely by the philological method, would conclude that it had laid bare the meteorological origin of every epic and folk-tale among the Indo-European peoples. He would learn that in a way rudely analogous to the supernatural guidance of the Christian Church, the several Aryan tribes had received from the fathers of the race an unvarying canon of interpretation of the primitive myths, a canon preserved with the jealous veneration with which the Jew regarded the Thorah and the Brahman the Veda. He would also learn that the details of Norse and classic myth can be traced to the Veda, that these details, not of incident alone, but of thought and expression, survived unimpaired by time and untouched by circumstance, whilst, strange to say, the more prominent names and the leading characters became obscured in their meaning. Strange indeed, but not true. For what is the fact?

Long before the hymns of the Rig-Veda existed as we know them (and they have remained an inviolate sacred text since 600 B.C., when every word, verse, and syllable were counted), the Aryan tribes had swarmed from their parent hive across boundless steppes and over winding mountain passes, some westward into Europe, others southward into Hindustan. Among the slender intellectual capital of which they stood possessed was the common mythology of their ancestors, in which, as we have seen, sun and moon, storm and thunder-cloud, and all other natural phenomena, were credited with personal life and will. But that mythology had certainly advanced beyond the crude primitive form and entered the heroic stage, wherein the powers of nature were half human, half divine. Their language had passed into the inflective, or highest stage, and had undergone such changes that the relationship between its several groups and their origin from one mother-tongue were obscured and remained so until laid bare in our day. In short, the Aryan tribes had attained no mean state of civilisation, some being more advanced than the others, according as external circumstances helped or hindered, and, one by one, they passed from the condition of semi-

civilised nomads to become fathers and founders of nations that abide to this day.

These being the facts to which language itself bears witness, how was it possible for their mythologies, *i.e.*, their stock of notions about things, to remain unaffected and secure of transmission without organic change? The myths, unfixed in literary form, yielded themselves with ease as vehicles of new ideas; their ancient meaning, already faded, paled before the all-absorbing significance of present facts. These were more potent realities than the kisses of the dawn; the human and the personal, in its struggles, of mightier interest than the battle of rosy morn or purple eve with the sons of thunder; and Homer's music would long since have died away were Achilles' "baneful wrath" but a passively told tale of the sun's grief for the loss of the morning.

In brief, the complex and varying influences which have transformed the primitive myth, are the important factors which the solar theorists have omitted in their attempted solution of the problem. They have forgotten the part which, to borrow a term from astronomy, "personal equation" has played. They have not examined myth in the light of the history of the race; and the new elements which it took into itself, while never wholly ridding itself of the old, have escaped them. They have secured a mechanical unity, whereas, by combination of the historical with their own method, they might have secured a vital unity.

To all which classic myth itself bears record. The Greeks were of Aryan stock, but when they arrived in Europe is unknown. The period between their settlement and the Homeric age was, however, long enough to admit of their advance to the state of a nation rejoicing in the fulness of intellectual life. They remembered not from what rock they were hewn, from what pit they were digged. The nature-gods of their remote ancestors had long since changed their meteorological character, and appeared in the likeness of men—or, at least, played very human pranks on Olympus. In the Veda, the primitive nature myth, although exalted and purified, is persistent; under one name or another it is still the ceaseless battle between the darkness and the light; Dyaus was still the bright sky, the cattle of Siva were still the clouds. But the Greek of Homer's time, and his congener in the far north, had forgotten all that; the war in heaven was transferred to the strife of gods and men on the shores of the Hellespont and by the bleak seaboard of the Baltic. Their gods and goddesses, improved by age and experience, put off their physical and put on the ethical; the Heaven-father became king of gods and men, source of order, law and justice; the sun and the dawn, Apollo and Athênê, became wisdom, skill, and guardianship incarnate. And the story of human vicissitudes found in solar myth that "pattern of things in the heavens" which conformed to its design. Thus Homer, in whose day the old nature-myth had become confused with the vague traditions of veritable deeds of kings and heroes but dimly remembered, touched it as with heavenly fire unquenchable. The siege of Troy, so say the solar mythologists, "is a repetition of the daily siege of the east by the solar powers that every evening are robbed of their highest treasures in the west." It is surely with a truer instinct that while we contend for that physical origin of the great epics to which their remarkable agreement witnesses, we also feel that the vitality which inheres in them is due to whatever of human experience, joy, and sorrow are the burden of their immortal song. As to the repulsive features of Greek myth, one can neither share the distress of the solar theorists nor feel their difficulties. Both are self-created, and are aggravated by the assumption of "periods of temporary insanity through which the human mind had to pass," as the rude health of childhood is checked by whooping-cough and measles. They are explained by the persistence with which the lower out of which man has emerged asserts itself, as primary rocks pierce through and overlap later strata. The ancestors of the Aryans were savages in the remote past, and the "old Adam" was never entirely cast out; indeed, it is with us still. There are superstitions and credulities in our midst, in drawing-rooms as well as gipsy camps, quite as gross in nature, if less coarse in guise, as those extant among the Greeks. The future historian of our time, as he turns over the piles of our newspapers, will find contrasts of ignorance and culture in our midst as startling as any existing in the land of Homer, of Archimedes, and Aristotle. Spirit-rapping and belief in the "evil eye" have their cult among us, although Professor Huxley's "Hume" can be bought for two shillings, and knowledge has free course. And it certainly accords best with all that we have learnt as to the mode of human progress to believe that the old lived into the new, than that the old had been cast out, but had gained re-entry, making the last state of the Greeks to be worse than the first.

In this matter the Vedic hymns do not help us much They are the products of a relatively highly-civilised time; the conception of sky and dawn as living persons has passed out of its primitive simplicity; these heavenly powers have become complex deities; there is much confounding of persons—the same god called by one or many names. The thought is that of an age when moral problems have presented themselves for solution, and the references to social matters indicate a settled state of things far removed from the fisher and the hunter stage. Nevertheless, there lurk within these sacred writings survivals of the lower culture, traces of coarse rites, bloody sacrifices, of repulsive myths of the gods, and of cosmogonies familiar to the student of barbaric myth and legend.

Enough has been said to show that the extreme and one-sided interpretations of the solar theorists are due to a one-sided method. The philological has yielded splendid results; this they have done; the historical yields results equally rich and fertile; this they have left undone. Language has given us the key to the kinship between the several members of the great body of Aryan myths; the study of the historical evolution of myths, the comparison of these, without regard to affinity of speech, will give us the key to the kinship between savage interpretation of phenomena all the world over. The mythology of Greek and Bushman, of Kaffir and Scandinavian, of the Red man and the Hindu, springs from the like mental condition. It is the uniform and necessary product of the human mind in the childhood of the race.

An extraordinary run was recently made by an engine attached to one of the steam dynamos in the Edison Central Station, Pearl-street, New York, which ran for seventeen days and nights successively, with a load varying from a minimum of 40-horse power to a maximum of 150-horse power indicated. The engine which accomplished this feat is a "Lawrence" direct-acting high-speed engine, running at 350 revolutions per minute. If we suppose the engine to have had a 5-feet driving-wheel attached, this performance would have been equivalent to that of a locomotive making the circuit of the globe at the equator. The bearings of the engine when stopped were not found to be unduly heated.

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

By Dr. Andrew Wilson, F.R.S.E., &c.

NO. X.—THE BLOOD.

WHEN the voice of ancient authority declared the blood of the body to be its "life," the statement was one which the experience of everyday life seemed fully to support. The physiologist of to-day will not quarrel seriously with the ancient rendering. He knows the impossibility of defining this mystic "life" of ours, which appears now as diversity in unity, and then as unity amidst variety of the most complex kind. He also knows that many other parts or components of the body might with equal justice be named the "life"—at least, in the sense in which the blood has been so termed. The top of the spinal cord (or *medulla oblongata*, as this part of the nervous axis has been named) might, perhaps, with greater force than the blood, be named the "life," since we can lose a pint or two of blood and recover perfectly from the depletion, whilst a prick with a pin in the medulla would cause instant death. Similarly, the heart might quite appropriately be named the "life," in the sense of the absolute necessity of its action for the continuance of the circulation. The "breath," also, is the "life" in a very plain and unmistakable sense, since interference with the breathing function means primarily death to the blood itself. But when we consider that the blood-flow is incessant, that it travels to all parts of the body, and that its failure means deprivation of food to the tissues, as well as the want of heat-production, we can readily enough find ample justification for the words of ancient wisdom with which we opened this paper.

What is blood? An important question this, and one which may be answered in at least three ways—firstly, *physically*; secondly, *chemically*; and thirdly, *microscopically*. Let us, firstly, endeavour to ascertain the *physical characters* of blood, or those which blood exhibits when regarded merely as a particular kind of fluid. To the naked eye, blood appears of a bright red colour as it flows in the arteries—that is, when it is pure; whilst it is of a purple colour when, in an impure state, it circulates through the veins. Microscopically, as we shall presently see, blood is not really red in hue, but owes its colour to the numerous red bodies (or *corpuscles*) which float in it. Blood is feebly alkaline in its reaction, and this alkaline character decreases from the time of the removal of the blood from the body, and until it clots or "coagulates."

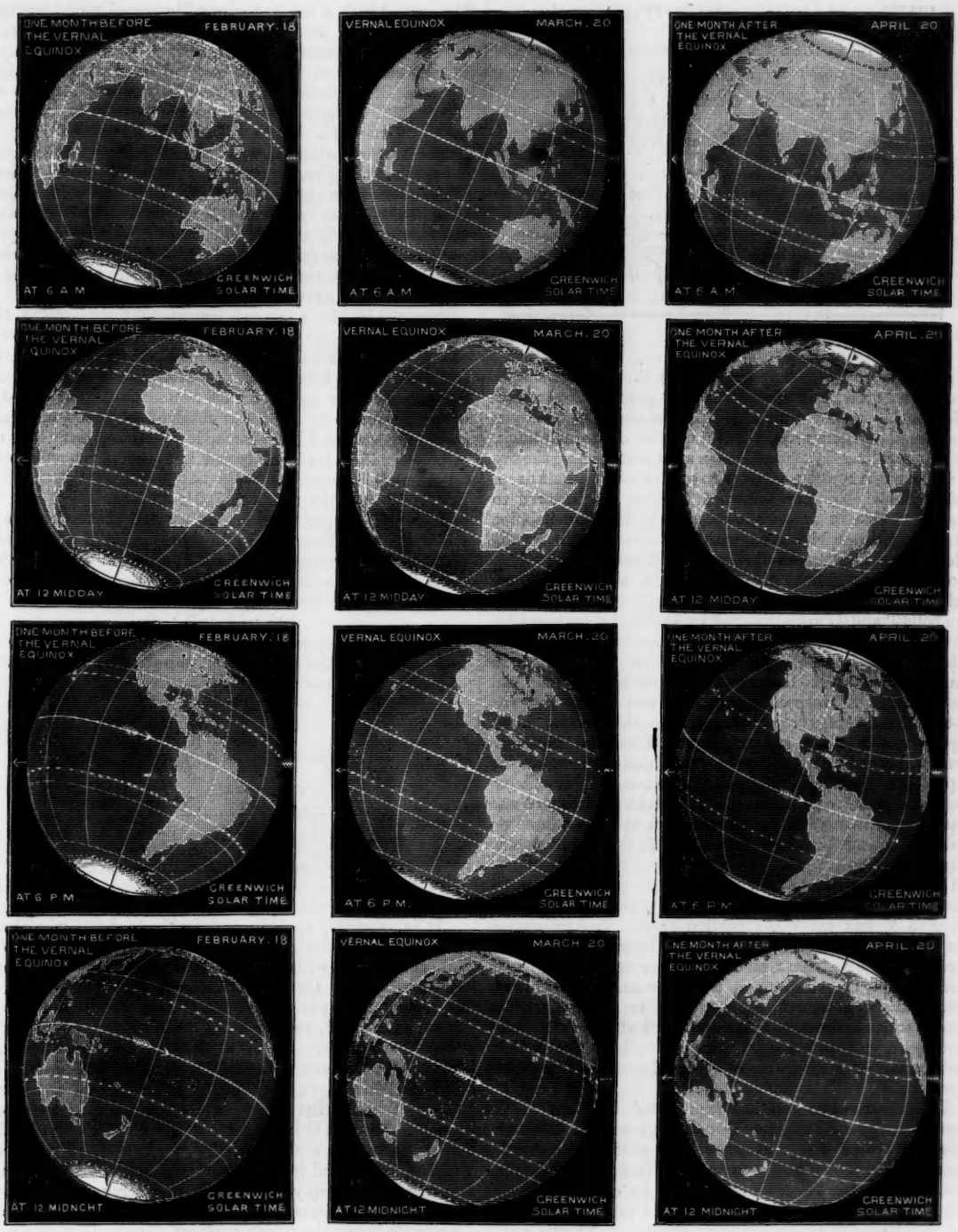
When drawn from the body, blood "clots." From two to five or six minutes suffice for this action. At first, the blood appears as a red jelly; but, ultimately, the clot sinks to the bottom of the vessel, leaving a straw-coloured liquid above. Blood thus practically analyses itself before our eyes, into a solid part, the *clot*, and a liquid part, the *serum* or *plasma*. The clot consists of the *corpuscles* or *globules* of the blood (most of them *red*, hence the character of the clot) entangled in a substance called *fibrin*. The liquid, or *plasma*, is the normal liquid or fluid part of the blood itself. This fluid, the microscope shows us, is as clear as water, and owes its apparently red colour, as already remarked, to the red globules that float in it. It is owing to a few of these red corpuscles remaining suspended in the plasma, that the liquid part of the blood in the "clot" seems to be straw-coloured. If we whip up or switch the blood with a bundle of twigs, just after it has been shed, no clotting takes place. In such a case, we whip out from the blood the fibrin which entangles the red corpuscles, and which adheres in strings or shreds to the twigs.

The *chemical composition* of the blood may be very shortly dealt with. A fluid which is supplied to every part of the body, and from which each organ or tissue derives the materials wherewith to renovate and repair its substance, might reasonably enough be expected to present us with a fluid epitome of the entire frame. And so, in truth, do we find blood to exhibit a composition of wide and generalised character. We discover, for instance, that blood contains about 784 parts of *water* per 1,000; it is rich in *albumen*; it contains *fatty matters*; it has a complex list of minerals, such as common salt, chloride of potass, phosphates of lime and magnesium, carbonate of sodium, &c.; and it shows on analysis, colouring matter, gases, and a number of substances derived from the waste of the body. Another fashion of showing the chemical composition of blood, brings out its elementary constitution as follows:—Carbon, 57·9; hydrogen, 7·1; nitrogen, 17·4; oxygen, 19·2; ashes, 4·4. From such an estimate, we see that blood contains materials adapted for supplying all the tissues of the body in the reparative work which is incessantly being performed.

Under the *microscope*, a thin film of human blood is seen to consist of a clear liquid—the *plasma*—in which float two kinds of bodies. These are the *red* and *white corpuscles*, or "globules," as they are often popularly named. The blood derives its red colour from the immense number of red corpuscles which float in its liquid. The white globules are less numerous; about one white corpuscle existing to 400 or 500 red ones. The microscope enables us to see in between the globules, and thus to perceive the clear liquid. To the naked eye, conversely, the blood appears uniformly red, because the globules are so numerous, and because we cannot perceive the liquid in which they float. Each red corpuscle of man measures in breadth about $\frac{1}{3200}$th of an inch, and in thickness about $\frac{1}{10000}$th of an inch. In shape it is biconcave, or hollowed on either side, and is coloured red by a substance called *hæmoglobin*. It is this substance which is affected by the *oxygen* we breathe into the blood, and by the *carbonic acid gas* the body and tissues at large excrete into the blood. The *white corpuscles* of man's blood measure in diameter, each, about the $\frac{1}{3200}$th of an inch. Each contains a central particle, the *nucleus*. It appears to be this nucleus which, when liberated from the outer part of the white corpuscle and coloured red, *becomes a red corpuscle*. The red corpuscles of the blood are thus derived from the white ones.

The white corpuscles of the blood are known to possess the curious property of exhibiting movements similar to those seen in the *amœba*-animalcule. These corpuscles (like the *amœba*) can also absorb particles of solid matter, as the animalcule in question takes its food. The white corpuscle is, therefore, a particle of *living protoplasm*, possessing a vitality independent, in a measure at least, of that seen in the body of which it forms part. It is, indeed, a curious fact to ponder over, that rolling about in our veins and arteries; now worming their way through the walls of blood-vessels into our tissues, and now contracting and expanding their substance, are myriads of minute living specks, which, although part and parcel of our composition, are closely related in structure and life to the animalcules of the pool.

Spanish Iron Minerals.—The exports of iron minerals from Spain during the year 1880 amounted to 2,932,998 tons.



SUN VIEWS OF THE EARTH;

OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

WE give this week the four sun views for April, showing the sun at 6 A.M., noon, 6 P.M., and midnight, Greenwich mean time, as supposed to be seen from the sun. For comparison, and to show the varying pose of the earth as the year proceeds, we give the corresponding sun views for March and February.

XUM

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—X.

IN order to obtain a conveniently-complete set of Bridge coils, it is advisable to construct a small resistance-box, holding four coils, so adjustable as to be able to perform the functions of Coils A and B (Fig. 2, Electrical Measurement VIII.).

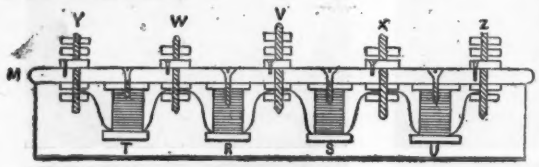


Fig. 1.

The accompanying diagram (Fig. 1) illustrates a simple form, based on a design similar to that previously described (Electrical Measurement VII.). M is a sheet of ebonite or other insulating material, about a quarter of an inch thick, and 8 inches long, by 2½ or 3 inches wide, and forming the top of a box an inch and a quarter to an inch and a half deep. Four ebonite, ebony, or boxwood bobbins are screwed to the under side of M as shown at T R S U, the bobbins being first carefully wound with silk-covered wire by the "double-winding" method (Electrical Measurement VII.), two of them, R and S, offering ten ohms resistance, and the other two, T and U, offering 100 ohms each. The coils T and U are connected by one of their extremities to the under screws of Y and Z respectively, the other extremities being similarly connected to W and X. In the same way, R and S are connected at one end to W and X respectively, the other ends of the 10-ohm coils being both connected to the central binding-screw, V. Short straps (Fig. 2, Electrical Measurement VII.) are placed between the binding-screws on the upper side of the ebonite plate, and removed or disconnected at one end when the subjacent resistances are required. An extra nut is provided on the central and on each of the end binding-screws (V Y Z) for the necessary wire connections.

One pole of the battery being put to earth, the other pole is joined to V, where the current divides, one portion going to Y and the other portion to Z. The resistance-box previously described (Electrical Measurement, VII.), is connected by a short piece of copper wire to Y (or Z), and the wire, or whatever it is the resistance of which is desired to be measured, is connected to Z (or Y). The remote ends of the resistance coils and of the wire being both either put to earth or brought back to the battery and connected to the pole which would otherwise be put to earth.

The galvanometer should be connected to Y and Z. It should, to be efficient, be wound with several layers of fine silk-covered wire, and the critical parts very carefully constructed. Too much stress cannot, in fact, be laid upon the necessity for the greatest care to be exercised in the construction of this instrument. The magnet should be comparatively small, and entirely enveloped by the coil, a light indicator being attached to it at right angles, and made to travel over a horizontal scale with the zero accurately marked. It is a great advantage to have a piece of silvered glass under it, so that, in looking down on the indicator, the shadow would be invisible, and a correct reading taken. If properly made the galvanometer should indicate, with low resistances and a powerful battery in circuit, an error in measurement of a hundredth of an ohm.

The cost of such a box as the one illustrated would be very small, while the arrangement of the coils and terminals render the apparatus of great utility in a variety of ways. It may be used as an ordinary set of resistance coils, and as a Bridge coil it permits of a very useful series of proportions. Suppose, for example, we wish to measure the resistance of a length of wire, that we are not particular to the fraction of an ohm, and that we have reason to believe it will give, say between 200 and 300 ohms. Then, disconnecting the straps over T and U, we vary the resistance in the larger box until the needle is unaffected, and the resistance of T and U (representing A and B in the proportion mentioned near the end of Electrical Measurement IX.) being equal, the resistance of the wire being tested is equal to that in circuit in the large box.

Suppose, in the next experiment, that we believe the wire which we join to Z offers between 2,000 and 3,000 ohms. Then, after short-circuiting T and disconnecting the strap over R (S being short-circuited), we again vary the resistance in the large box connected to Y, until equilibrium is produced. If this is obtained when 250 ohms are inserted between Y and earth, it is evident that the resistance of the wire being tested is 2,500 ohms, as shown by the simple proportion :—

10 : 100 :: 250 : 2,500

As a third experiment let us assume that our wire is under one ohm, then we should short-circuit U and R, and disconnect the straps over S and T, when, if the needle become stationary with five ohms in the large box, the wire will offer half an ohm, thus :—

100 : 10 :: 5 : ·5

If, under the same conditions, a balance is effected with 2·5 ohms, then the resistance of the wire will be a quarter of an ohm, thus :—

100 : 10 :: 2·5 : ·25

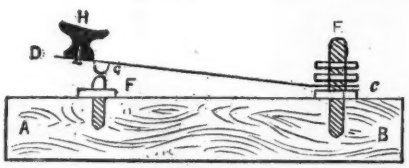


Fig. 2.

It is, generally speaking, advisable to have an arrangement for easily disconnecting and reconnecting the battery, otherwise there will, under certain circumstances, be great risk of injuring the galvanometer. Fig. 2 illustrates, in elevation, a simple device. A B is a block of ebony or other hard wood, two or three inches square, and half an inch or so thick. *c* D is a piece of thin brass or steel, about half an inch wide, rigidly fixed at one end by the screw E, and having just enough spring in it to separate G from F, when the finger, which by pressing the ebony knob H brought G into contact with F, is removed. F is a small contact stud, consisting, preferably, of a piece of platinum soldered to a brass or iron screw. It may, however, consist simply of a wood screw, screwed in from the underside of A B, the head being well sunk, so as not to protrude below the under surface. Similarly, G is a small piece of platinum wire or foil soldered to *c* D, but may, if desired, be dispensed with. The reason assigned for using platinum is, that it is much less oxidisable than brass or iron, and therefore preserves a clean contact surface. This "key" is placed between the battery and V of the Bridge coils, one wire being connected to E and the other to a binding screw, placed on any convenient part of A B, and connected to F. By this means, when H is depressed, the

current flows, and, when allowed to rise, the circuit is immediately disconnected.

So much for the Wheatstone Bridge. It is a set of apparatus the value of which is incalculable. By its means the practical electrician is able to detect almost every possible fault in a line, whether it be a disconnection, a partial oxidation of the conductor, an earth fault or leak, or, what amounts almost to the same thing, a metallic contact. Notwithstanding its paramount utility, there are engaged in the newer applications of electricity several so-called electricians who have no more knowledge of this method of testing than the proverbial lunar inhabitant. It will doubtless surprise many to learn that a man who was in charge of one of the most important experimental installations of the electric light once asked us to recommend a work on the rudiments of electricity; while on another occasion an "electrician" in the same company's employ, having to trace three or four wires, declined the offer of a battery and simple galvanometer, and preferred to cut a notch in a piece of wood and putting each wire in it in succession, followed the wires throughout their length over ceilings and under roofs, and through no end of rubbish to the various lamps. To the amateur and the experimenter in general the apparatus is equally a boon, and its use was well brought out at a meeting of the Society of Telegraph Engineers, on the 12th inst., when Mr. Shelford Bidwell showed how by its aid he had gauged the resistances of microphonic contacts under a multitude of circumstances.

The subject of electrical measurement, fraught as it now is with the highest importance, must be suspended for a time in these columns, to make room for a concise description of the various forms of batteries, their manufacture, principles, efficiency, and applications.

ON THE FORMATION OF COMETS' TAILS.

By A. S. Davis.

In his letter to Knowledge, for March 16, 1883, Mr. Ranyard has pointed out that the mode in which he conceives the force of recoil from evaporation to act in producing a comet's tail differs materially from that which has been proposed by me.

According to Mr. Ranyard's supposition, a mist, consisting of small particles which do not themselves undergo evaporation, envelopes the nucleus of a comet. Upon the particles of this mist matter of a more volatile kind is being continually precipitated on the cool side, and evaporated on the warmer sunny side. The matter thus precipitated and evaporated is, in the first instance, evaporated from the nucleus, and in streaming away into space is caught by the particles of mist. Mr. Ranyard thinks that each particle of the mist, before its passage into the tail, may condense and evaporate a quantity of matter many times its own mass, and may, in this way, acquire the velocity necessary to account for the formation of a tail, a velocity, namely, which, in many cases, must be many times greater than the relative velocity with which the molecules escape from the particle of mist upon evaporation.

Now against this view there appears to me to be an insuperable objection. Mr. Ranyard has, in fact, left out of account one of the forces acting upon the supposed particles of mist. In addition to the four forces he enumerates,—viz., the gravitation towards the nucleus and the heat repulsion from the nucleus, the gravitation towards the sun and the heat repulsion from the sun,—there will be the force arising from the resistance to motion through the supposed atmosphere.

Now, by the time that the particle has acquired a velocity away from the sun equal to the average velocity with which the molecules escape on evaporation, this resistance will have become equal to the force due to recoil from evaporation; for by the hypothesis as much matter is met with as is afterwards evaporated, and since the relative velocity with which the molecules meet the particle will then be at least equal to the relative velocity with which they leave the particle, any further increase of velocity away from the sun will be impossible. Thus, on Mr. Ranyard's hypothesis, the velocity of the particles tailwards could never be as great as the average velocity of translation of the molecules of gaseous matter due to thermal energy, however great might be the quantity of matter precipitated on them and afterwards evaporated.

Mr. Ranyard states that he has been driven to make this hypothesis of a mist of small particles on which matter is being precipitated and afterwards evaporated, from the difficulty of conceiving of the precipitation and subsequent evaporation of the same substance in the neighbourhood of a comet's nucleus. But, I would ask, where does this difficulty arise? Let us suppose that a comet on its approach to the sun consists of an agglomeration of blocks of matter more or less loosely compacted about a nucleus, that these blocks are of very various sizes, and that some of them consist of matter almost wholly volatilisable by the sun's rays, if continued long enough. From the extreme smallness of the mass of a comet, it would be impossible for it to retain any permanent atmosphere, and any matter volatilised by the sun's heat would at once fly off into space. On its approach to the sun, such a current of gaseous matter would be set up by the sun's heat. At and about the nucleus, where the cometary matter is most thickly clustered, this current would be sufficiently powerful to carry along with it some of the smaller masses of meteoric matter. It may be noted that a very small force would suffice for this, seeing that the gravitating force of the comet must be almost *nil*. The matter thus carried away, and for the most part towards the sun, since the evaporation would be on the sunny side of the nucleus, would, however, itself be undergoing evaporation, and when the matter had been carried so far from the nucleus as to be almost entirely free from the current of gas setting outwards, then the force of recoil due to the evaporation of its own substance would begin to tell upon its motion.

My illustration of a block o ice, equal in mass to a cubic mètre of water, enclosing a gramme of sand, was chiefly taken as one admitting of very ready calculation. It would appear more probable that the volatile substance in many comets is some hydro-carbon, either frozen solid or in the liquid state. Some of the meteoric masses would probably be almost entirely made up of this hydro-carbon, either broken off, or splashed off, from larger blocks by their collision, and containing, perhaps, the merest trace of non-volatile material enclosed or dissolved in them. Such masses on volatilisation would ultimately attain an enormous velocity. As regards the continued emission of large tails by a comet, having the constitution I have supposed, even after several returns to perihelion, this would be quite possible if the comet contained a nucleus having a core, even a few miles in diameter, in which the masses were so thickly clustered as to make it impenetrable by the sun's rays.

Mr. Ranyard observes that the velocity I obtain in my example is only 295,000 miles per day, whereas velocities

of at least five or six million miles per day have to be accounted for. Now, in my example I supposed the temperature of evaporation to be 0°C. In the extreme cases, where velocities of five or six millions of miles have been observed, the perihelion distances of the comets have all been very small, and the temperature of evaporation must have been enormously high. By assigning a very high value for the temperature, and at the same time supposing a much smaller proportion of non-volatile material to be present in the block, it is plain that the velocity obtained by calculation would quite reach that observed even in the most remarkable instances of rapid tail formation.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

A NEW PARADOXER.

[789]—I wish to explode the most vile and degraded superstition that ever disgraced the world. I can find no language coarse enough to characterise the swindlers and idiots who hold it. I allude to what is known as the 47th Proposition of the First Book of Euclid. I can *prove* it is false, Sir. You ask how. Simply by *denying* it, and by challenging its supporters to prove it to *me*. Yes, to me, Sir. Their name is legion, and I am a solitary one. Yet I defy them all. They cannot even drag me over the Asses' Bridge. It is this ground upon which I take my stand. If further argument is needed, I beg to say that vile scoundrel Euclid never paid his washerwoman. If any one dares deny what I say, let him back his statements by proof. Let him bring one receipt from that injured woman. Sir, after this, how *can* the squares on two sides of a right-angled triangle together equal that on the hypothenuse?

Bedlam, April 1. Mad Tom.

P.S.—I flatter myself I am not an unworthy disciple of the earth flattener.

CORSETS.

[790]—It having been unquestionably proved through the correspondence in Knowledge that corsets are unnecessary and injurious, the next step is to provide ladies who leave them off with some garment which, while supporting, allows of the free movement of the body without injurious consequences.

I suggest that the Rational Dress Society should bring out a tight-fitting jersey, made of the same material as is used in the manufacture of elastic stockings worn for varicose veins, and so satisfy those ladies who *will* wear something of that nature.

I shall be glad to hear of any objections (medical or otherwise) to this suggestion. C. Carus-Wilson.

[How about the circulation?—R. P.]

LETTERS RECEIVED.

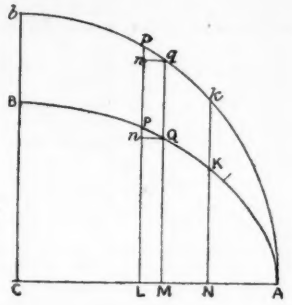
A. O. H. Lectures will not be published. Thanks for information about occult matters.—John Shaw. Yes, so I should imagine; a power to control the weather must be a key to meteorology. You are lucky in being "in possession of a gift of that kind."—H. B. You can hardly expect us to insert a letter from a correspondent who is not a regular contributor, and expects a copy of number containing his letter to be sent to him.—A. Sonnenschein. No; I did not ascribe to Herbert Spencer the idea of comparing the heavenly bodies to trees in various stages of development. Oddly enough, I was reading over, the day of the lecture, the passage you quote from Humboldt's "Cosmos." Sir W. Herschel presented the idea earlier, in reference to nebulæ.—H. M. C. Many thanks, but the phenomenon is so clearly referable to peculiarity in arrangement of clouds, that it would hardly be worth while to make an engraving.—H. Crofts. The word "religion" does not necessarily imply the slightest trace of belief in such matters as you mention. It is, strictly speaking, simply that which keeps men in the path of duty.—A. Wrigley.—R. N.—W. Gorrie.—A. W. Blomfield. Thanks.—E. A. S. Thanks.—S. E. Clark. From De Morgan's illustration of his own puzzle (see back numbers of Knowledge, it is clear he meant it as we presented it.—W. G. Rolfe. Thanks, but must keep now to what all agree in liking.—Joseph Clark. Why is the *sky* blue?—J. H. Tanner.—Faciebat. The test is, can either "but" or "which" be left out without making the meaning different from what was intended? You will find that neither can.—Coracoid. Out of print.—A.—A. S. Davis.—Room No. III. Have written no article relative to purchasing power of shilling.—C. Etherington. "Creatures like any known to us" was my expression. Does not that leave open for you the wide field of conjecture you mention? I did not myself want to enter that field.—H. N. D. Have sent your query to Mr. Browning.—H.—Student. Among the varied pieces of information which have reached me, none tells me how to lessen excessive fleshiness at the end of the nose.—R. H. Not H., but a man who has gone under the name of Parallax, published a book on that silly theory.—A Sun Worshipper. If the press would give reasonable support to scientific lectures, the afternoon lectures you invite might well be given; but they do not.—Æon. You are a sun-worshipper of another kind, if in earnest. But, surely, your letter is an elaborate joke.—Myopia.—Walter Jones.—A Subscriber.—F.R.A.S. Thanks.—H. M. Wilkinson.—W. M.—Harveian.—H. L. I did *well* to speak strongly against such mischievous folly as Mr. Wiggins displayed. I retract not a word. Those who hearkened to him were unwise, but those who defend him after the event has shown how idly he spoke, are worse than unwise.—A Little Girl. My dear child, your "experience" (you will learn to spell experience with more e's soon) is as yet limited. All the ladies who have thus far, to *my* knowledge, left off wearing corsets have had small waists, even singularly small waists; yet you are so hard, you sarcastic little girl, as to say that only the large-waisted leave off stays (!), and that "those with small waists are so proud of their fine figures that they draw themselves in as much as possible to make themselves still smaller."—H. S. Your telescope has an erecting eye-piece; it would be easy to get an astronomical eye-piece made for it.—G. Connolly. Lectures have never yet been committed to paper.

J. N. Lockyer.—Your unsigned post-card received. I should imagine the person mentioned in it is not, either by birth or breeding, by nature or by education, qualified to form an opinion on the subject touched upon. This I find to be the general verdict. But his name (the value of which you singularly over-estimate) shall in future be as rigidly kept out of these pages as you could wish; also from books and lectures of mine (those who heard my lecture on "The Sun" at St. James's Hall will explain to you what this means). I will be as careful in his case as in that of the earth-flattening person whose cause you seem to espouse. My friend the Editor of *Vanity Fair* showed his accustomed kindness in the matter you mention (quite misunderstanding it). Your card is unsigned and in a disguised hand; but you have overlooked the trifling circumstance that it refers to a matter sixteen months old, of which no one *could* know anything but yourself, except from yourself, and no one but you would have remembered the matter a day. (If not actually from you, yet] *Qui facit per alium facit per se*). That in regard to *this* matter you should have entirely misunderstood me is (for a reason suggested above) altogether natural. But internal evidence is not always a safe guide. I had no thought save to indicate publicly that desire to be on friendlier terms, which I had privately and in kindly words conveyed to you. Be it, however, as you will. Life is too short, and to me too pleasant, to be wasted over idle wrangling. You have had no warmer admirer of your best observational work than myself, who first made that work known, with just commendation, to the public; but, like the rest of us, the Editor (not being the Author) of *Nature* has made a few mistakes; and he does not very readily forgive those who pointed them out. Were it not for this, all (I take it) would have been well. Give the world some more good work like that of 1868 and the mistakes will be forgotten.—Richard A. Proctor.

Our Mathematical Column.

EASY LESSONS IN THE INTEGRAL CALCULUS.

THE study of the integral dealt with in our last, in its relation to the area of circular sections (whether sector, segment, or otherwise), leads naturally to the discussion of the areas of other conic sections.



The ellipse, however, requires no new application of the integral calculus. Thus, if B Q A is a right elliptical quadrant, C the centre of the ellipse, and the semi-axes C A and B C are a and b respectively, we know that putting C L $=x$ and P L $=y$, $y^2=\frac{b^2}{a^2}(a^2-x^2)$ and the area of the elementary rectangle Q L $=ydx$

$$=\frac{b}{a}\sqrt{a^2-x^2}dx$$

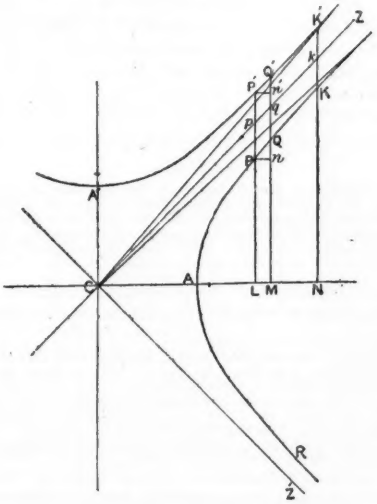
So that the area C B K N, in which C N $=x_1$,

$$=\frac{b}{a}\int_0^{x_1}\sqrt{a^2-x^2}dx$$

$$=\frac{b}{a}\left[\frac{x_1\sqrt{a^2-x_1^2}}{2}+\frac{a^2}{2}\sin^{-1}\frac{x_1}{a}\right]$$

$$=\frac{b}{a}\text{area } CbkN$$

When we turn to the hyperbola, however, we find ourselves led to a new integral, and a new application of the integral calculus. (In passing, I wish the reader to notice that my chief object in going over thus the discussion of the simpler integrals, and those more commonly employed, is to associate this part of the student's reading with the actual application of the calculus.)



If K P A R is part of a rectangular hyperbola, A the vertex, C the centre, and C Z, C Z′, the asymptotes; and if C L $=x$, P L $=y$, we know that $y^2=x^2-a^2$ (where C A $=a$), and taking an ordinate K N, we have, the area of an elementary rectangle P M $=ydx$,

$$=\sqrt{x^2-a^2}\,dx$$

so that the area A K N, in which C N $=x_1$

$$=\int_a^{x_1}\sqrt{x^2-a^2}\,dx$$

to determine which we must integrate $\sqrt{x^2-a^2}dx$, not as yet among the quantities whose integral is known to us. Before trying to do this, let us consider the conjugate hyperbola A′ P′ Q′. Here, completing the construction shown in the figure, we have, if P′ L $=y$,

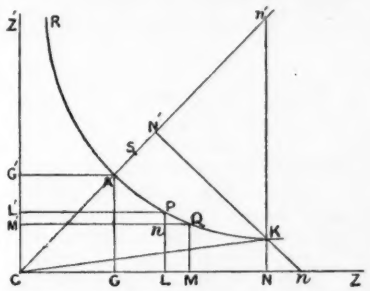
$$y^2=x^2+a^2$$

and the elementary rectangle P′L $=\sqrt{x^2+a^2}\,dx$; so that the area AK′ N, in which C N $=x_1$

$$=\int_0^{x_1}\sqrt{a^2-x^2}dx$$

involving also a new integral, but nearer in form (note the limits of the integration) to what we obtained in the case of the circle and the ellipse.

We still refrain from the work of integration, because we know from a familiar property of the hyperbola, that there is yet another way of dealing with the curve which will probably give us the area more readily, and therefore show us how to integrate* $\sqrt{x^2-a^2}\,dx$ and $\sqrt{x^2+a^2}\,dx$ without our being at the pains to deal directly with these, after any of the tentative methods yet described.



Take the rectangular hyperbola R A K with CZ and CZ′, the asymptotes, for the axes of reference. Draw C A S, the axis, and A G, P L, Q M (near to P L), K N, all perpendicular to C Z.

Then C A $=a$ and C G $=\sqrt{2a}=a_1$ (for convenience). Also, let C L $=x$, C M $=x+dx$*, C N $=x_2$ (to distinguish from the x_1 of our former inquiry). Then, if P L $=y$, we know that, drawing P L′ and A G′ perpendicular to C Z′, rectangle L′ L = square G G′ $=a_1^2$; *i.e.*, $xy=\frac{a^2}{2}$. Hence $y=\frac{a^2}{2x}$; elementary rect. Q L $=\frac{a^2}{2x}dx$, and area G A K N.

$$=\int_{a_1}^{x_2}\frac{a^2}{2x}dx=\frac{a^2}{2}\left[\log x_1-\log a_1\right]$$

$$=\frac{a^2}{2}\log\frac{x_1}{a_1}$$

Now draw K N′ perp. to C A S, and put C N′ $=x_1$. Also join C K. Then we note that $\triangle$ C N K $=\triangle$ C G A, so that, taking each in succession from the area C A K N, we have area C A K = area A G N K (which we have just determined).

Now area A P K N′ $=\triangle$ C N′ K − area C A K; therefore we now have the area A P K N′ in the toils. For

$$\triangle C N'K=\tfrac{1}{2}C N'\,.\,N'K=\tfrac{1}{2}x_1\sqrt{x_1^2-a^2}$$

$$\text{Area } C A K=\text{area } G A K N=\frac{a^2}{2}\log\frac{C N}{C G}$$

But if we draw N K n', N′ K n, as in the figure, we know that

$$C N=N n'=\frac{C n'}{\sqrt{2}}$$

* We do not any longer write δx and afterwards change to dx, but the reader will, of course, understand that dx is not really a finite increment, like L M, but is what this increment becomes as Q M, in its approach to P L, is just about to merge into P L.

So that $\frac{CN}{CG} = \frac{Cn'}{\sqrt{2}CG} = \frac{Cn'}{CA} = \frac{CN'+N'n'}{a}$

$$= \frac{CN'+N'K}{a} = \frac{x_1+\sqrt{x_1^2-a^2}}{a}$$

Wherefore area $APKN' = \frac{1}{2}x_1\sqrt{x_1^2-a^2} - \frac{a^2}{2}\log\frac{x_1+\sqrt{x_1^2-a^2}}{a}$

(To be continued.)

ERRATUM.—Doubtless you have discovered the slip in the numerical part of the "light absorption" problem (putting $\bar{4}\cdot6090600$ as the equivalent of $-3\cdot3010300$). But would not the steps of the working be clearer thus:—

$$\log\rho = -\frac{\log 2000}{88000}$$
$$= -\frac{3\cdot30103}{88000}$$
$$= -\ \cdot0000375$$
$$= r\ \ 9999625$$
$$= \log\cdot9999137$$

(There are five 9's printed in this decimal in KNOWLEDGE; but that is clearly a printer's error, as you quote the fraction correctly.)

The absorption $= \frac{863}{10,000,000}$ = one 11,587 (nearly). W.

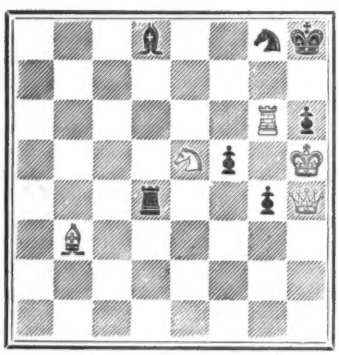
Our Chess Column.

By MEPHISTO.

PROBLEM No. 85.

BY J. C. S.

BLACK.



WHITE.

White to play and mate in three moves.

THE INTERNATIONAL CHESS TOURNAMENT.

THIS great event, which has been looked forward to with the greatest amount of interest by chess players all over the globe, will commence on the 26th inst. Needless to say that nearly all the best players will compete. The following have already signified their intention of joining the tournament:—Steinitz, Zukertort, Mason, Blackburn, Potter, and Bird from England, Mackenzie from America, Winawer from Berlin, Schwarz from Vienna, Dr. Noa from Hungary, and Tschigorin from Russia, besides several others. Prizes of the value of £1,000 will be given, the first prize being fixed at £300.

Concurrently a minor tournament will be played, intended for young players, or those who are not absolute first-rates. The prizes in this tournament will be £60, £50, £40, £30, £20, &c., with less severe play regulations than in the major tournament. It is expected that this tournament will be very popular, and that a large number of good players will compete. The tournament will take place at the Criterion. To spectators, an entrance-fee of 2s. 6d. will be charged for each sitting. Time of play will be from twelve to five and from seven to midnight. We shall endeavour to publish regular reports, as well as games, of the leading players in both tournaments.

ONE of eight games, played by Mr. Zukertort simultaneously without sight of the boards, at the North London Chess Club on the 14th inst.:—

SICILIAN DFFENCE.

White. Zukertort.	Black. Amateur.	White. Zukertort.	Black. Amateur.
1. P to K4	P to QB4	14. P takes P	P takes P
2. Kt to QB3	P to K3	15. Kt takes Kt	P takes Kt
3. Kt to B3	P to QR3 (*a*)	16. B to B4 ch	K to R sq
4. P to Q4	P takes P	17. R to B3	P to B4
5. Kt takes P	B to Kt5	18. KR to K3	Kt to Kt sq (*e*)
6. B to K2 (*b*)	B takes Kt (ch)	19. B takes Kt	R takes B
7. P takes B	Kt to K2	20. R to K7	Q to B3
8. Castles	Castles	21. P to B4	B to Kt2
9. B to R3	P to Q3	22. B to Kt2	QR to K sq (*f*)
10. P to KB4	Q to B2	23. B takes P(ch)	R takes B
11. Q to Q2	R to Q sq	24. R takes R(ch)	R to Kt sq
12. B to Q3	P to B4 (*c*)	25. Q to B3 mate.	
13. QR to K sq (*d*)	Kt to B3		

NOTES.

(*a*) 3. Kt to QB3 is preferable.

(*b*) We prefer 6. B to Q3.

(*c*) Black ought to have brought his pieces more into play by 12. QKt to B3, to be followed by P to K4 or Q4 accordingly, but his position was not good, on account of his weak P on Q3, and the White B on R3—always a bad combination in this opening.

(*d*) This, and the following moves are well calculated, and White obtains a commanding position.

(*e*) White plays with marvellous precision, in spite of his conducting eight games blindfolded. Black has no other move, for if 18. R to K sq. 19. B to B7. If 18. Kt to Kt3. 19. R to K8 (ch), Kt to B sq. 20. Q to Q5 (threatening mate on Kt8), B to K3. 21. R (K sq) takes B, R takes R. 22. R takes R and wins.

(*f*) An unfortunate move, which enables Zukertort to finish in good style.

SOLUTIONS.

PROBLEM No. 82, BY A. J. MAAS, p. 213.

1. R to B4	B takes Q or		K to K3
2. R takes P	Anything	2. R to B5 ch	K to Q2 or B3
3. Kt mates		3. Q to Kt5 or Q4 mate.	

If 1. K to B3. 2. Q takes B (ch), K to B2. 3. R to B8 mate, or 2. K to Kt4. 3. Q takes P mate.

If 1. K to K5. 2. Q to B2 (ch), if 2. K to K4. 3. Q to B5 mate, or if 2. K to Q4. 3. R to B5 mate.

No. 83. BY C. H. BROCKLEBANK, p. 213.

1. Kt to B3	P takes Kt or		B takes P
2. Q to Q8	Anything	2. Kt to Q4	K takes Kt
3. P to Q4 mate		3. Q to Q6 mate.	

If 1. B to B8. 2. Q to Q8 and mates next move.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Henry Erskine.—Game received with thanks.

Correct Solutions Received.—Problem No. 82 Berrow, R. J. P., G. W. Thompson.—No. 83 John, M. T. Hooton.—No. 84 W.

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